SAN ANTONITO
STEM MAGNET
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San Antonito STEM Fair:

Science Project Guide

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What is a Science Project?

A Science Project tests a hypothesis using the scientific method. You can tell you have a science project if you are measuring a variable. Science Projects may be experiments, correlation, or observations. Here is a little more about those types of Science Projects:

- Experiments: These kinds of projects involve trying to find a cause and effect relationship. They have dependent variables that are being measured and independent variables that are being changed. The independent variable is the only thing changing while all other variables are kept the same. In the video, “Which should I chose?” the scientist tested the question “Which food will attract the most birds to my yard?” The dependent variable was the number of birds visiting each food and the independent variable was the type of food.

- Correlation: These kinds of projects involve establishing a relationship between two variables. These projects have variables that predict and outcome. Examples include “How does temperature affect the amount of food eaten by my dogs?” or “Does the amount of sleep a person gets impact their reaction time?”

- Observations: These kinds of projects involve observing a natural event or phenomenon to answer a question. These projects identify important variables to observe and use a systematic way to do observations. Examples include: “How kind are people at the grocery store?” or “What is the survival rate of seeds harvested from my salad tomato?”

Remember, a science project does NOT simply demonstrate or model a science idea. A science project asks a question, then uses the scientific method steps to get data to prove or disprove your hypothesis.

What is the Scientific Method?

The Scientific Method is the series of steps, or procedure, that scientists like you use to answer scientific questions. All of your steps should be recorded in a science journal! You can use blank paper or a notebook - but it's important to write down your steps and research and especially your data. Keep all your writing together.

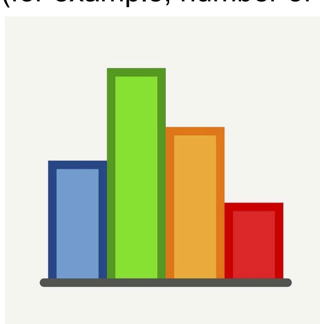
- Question:
    - The first step in your science project is writing a question. What do you want to learn more about? In our example video, the scientific question was "Which food will attract the most birds to my yard?"
- Research:
    - Once you have written your question, you need to do some research. What similar questions have scientists already asked? You need to become an expert in your topic. Record any science words and their definitions. Write down important things you have learned! You might want to interview an expert in this field. For example, our video scientist might have interviewed an ornithologist - someone who studies birds. Keep track of all the books and articles you have read, and people you have interviewed
        - When you're getting ready to present your science project, you will need to create a **bibliography**. This is a list of all the books, articles, websites, and people you have used for research. Use the Calvin Library (https://www.calvin.edu/library/knightcite/) site to help you create your bibliography. It is okay for young students to cite in resources in age appropriate ways, for example "I talked to a scientist/my mom/an expert…" or "I read a book that said…."
- Hypothesis:
    - What do you think will happen? Now that you have done your background research, it is time to answer your own scientific question with a hypothesis. This is your best guess or prediction of what you think will happen when you test your question. For example, our video scientist might have made a hypothesis like "I think more birds will be attracted to blueberries." Be sure to write down your hypothesis in your science journal!
- Experiment:
    - How can you test your question? Here's where you design your experiment procedure.
        - Your experiment should have one (1) **independent variable**. This is the thing you are testing. For example, our video scientist's independent variable was the type of food they put out to attract birds. You should only test one variable at a time in order to get accurate results.
        - Variables that you don't change are called **controlled variables**. For example, if our video bird scientist had put each different food in a different type of feeder, they wouldn't know if the feeder or the food was

what attracted the most birds. The location of the food and type of feeder are controlled variables.

        - After you have figured out your independent variable and controlled variables, you need to write down the steps of your experiment. Make sure you write down every step you plan to take and all the materials you plan to use.
        - Next, test, test, test! To have a good experiment, you should do the experiment more than once - AT LEAST three times, but more is better! Take pictures as you go - you may want to use these in your presentation later.

- Record:
    - As you do your experiment, make sure you write down your **data**. Data are the observations, numbers, measurements or other information that should be collected as you do your experiment. For example, our video scientist used a tally to record how many birds visited each type of food.
    - It is best to organize your data in a way that is easy to read and understand. You might also need to use your data to create a **graph.** Here are some types of graphs you might want to use:
        - **Pie graphs** are good to use if you are showing percentages of groups. Remember that you can't have more than 100% and all the pieces need to add up to 100%. This type of graph is useful if you are doing a survey.

        - **Bar graphs** are good to use if you are comparing amounts of things because the bars show those amounts in an easy to read way. This way the judges will be able to tell your results at a glance. The x axis (horizontal) is where you label what is being measured (for example, type of food) and the y axis (vertical) is label to show the unit being measured (for example, number of birds that visited each food)



        - **Line graphs** are good to use if you are showing how changes occurred in your experiment over time. The x axis is labeled with time increments and the y axis is labeled to show what you are measuring.

- Conclude:
    - Now it's time to write your conclusion! Scientists must communicate their results to others. Tell what happened in your experiment. Was your hypothesis right or wrong or neither? Here is where you should write a claim supported by evidence. For example, our video scientist might say "I claim that more birds will visit my yard if I put out sunflower seeds. I know this is true because in my experiment the most birds visited the sunflower seeds compared to the other foods." You will want to include as much evidence as possible to support your conclusion. You might also refer to your background research to help you argue your claim.
    - Your conclusion should also include what you might change in the experiment. Was there something that didn't quite work correctly? Maybe there's a variable you wanted to control, but couldn't because of something out of your control like the weather. Make sure you include this in your conclusion.
    - Finally, tell why this experiment was important and what you might do next. Did your experiment lead you to another question? Is there something else you are curious about now?

Writing a Good Science Question

The first step in starting a science project is coming up with a good question. If you're stuck on deciding on an overall topic, check out some of the links in the "Getting Started" Guide. Once you have a topic, it's time to write a question. The question is the focus of your project and possibly even the title on your display board. Your question should be able to be tested and measured - BUT questions that can be answered with a "yes" or "no" should be avoided. Take a look back at the "What is the Scientific Method?" section to make sure your question has one independent variable and a dependent variable (what is going to be measured).

Here are some types of questions to help you get started:

"What Is The Effect" Question:

What is the effect of____________________on_________________________?

*Examples:

sunlight	the growth of plants
eye color	pupil dilation
brands of soda	a piece of meat
temperature	the size of a balloon
oil	a ramp

The Relationship Question:

What is the relationship between

_____________________and__________________________?

*Examples:

Amount of light	the growth of plants
temperature	Number of birds at the feeder
weight	Height jumped

"How Does It Affect" Question:

How does the____________________affect_________________________?

*Examples:

color of light	the growth of plants
humidity	the growth of fungi
color of a material	its absorption of heat

"Which/What and Verb" Question:

Which/what_________________________(verb)__________________________?

*Examples

paper towel	is most absorbent
foods	do meal worms prefer
detergent	makes the most bubbles
paper towel	is strongest

Timeline for Complete Your Project

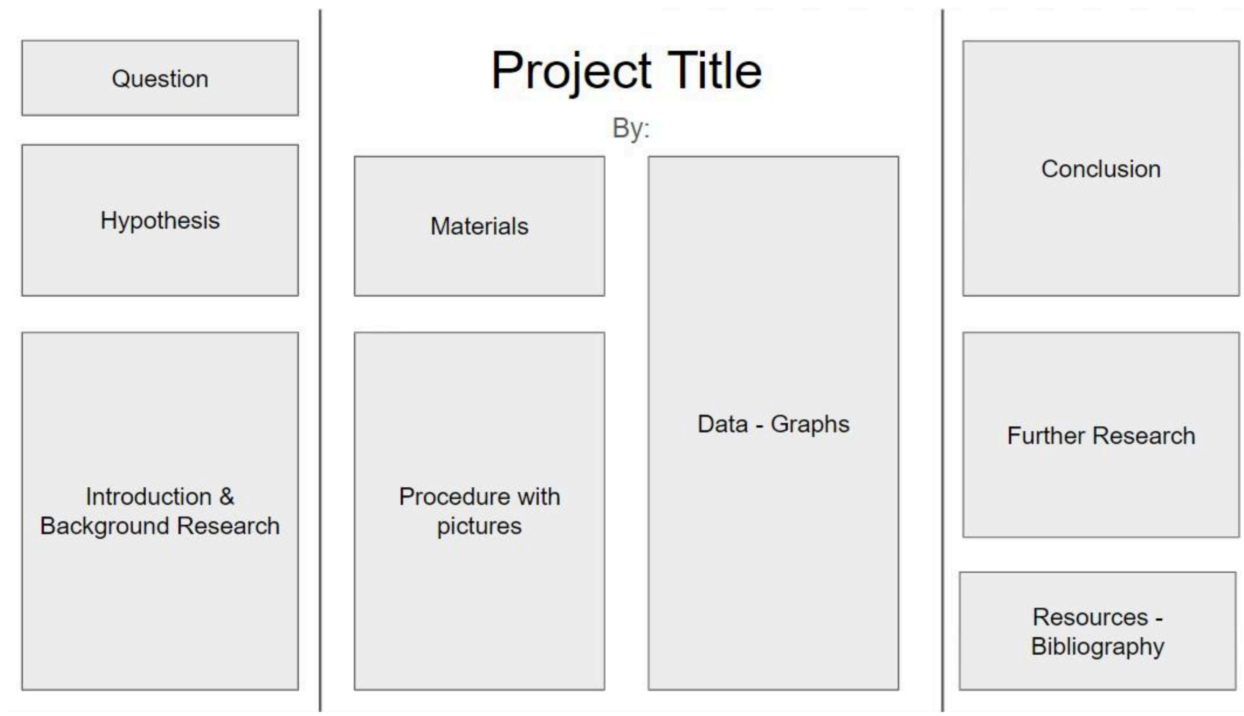
This is a suggested timeline to help you pace yourself in completing your STEM Fair project. All project ideas MUST be submitted to the SASM STEM Fair Committee (using the Google Form) by October 18th. This is to ensure projects that require prior approval by the Central NM Regional STEM Research Challenge have time to submit the necessary paperwork.

Project Part	**“Due” Date**
Question: Decide on your science question	September 13 - Submit your project idea to the SASM STEM Fair Committee (suggested timeline). *MUST BE SUBMITTED BY October 18!
Background Research: Research your topic! What have others done related to this topic? Edit your question if you need to.	September 27
Hypothesis: Write your hypothesis. Be sure to include background research to support your prediction.	October 4
Conduct your Experiment: Remember, you should do multiple trials for a science experiment! Collect your data.	October 25
Improve: Identify challenges with your plan, go back and edit your plan if needed. Collect additional data.	November 8
Conclusion & Next Steps: Review your data. Was your hypothesis correct? Why or why not? What would you test next?	November 26
STEM Fair Presentation: Create your STEM Fair Board and practice your verbal presentation you will make to the judges	December 12 - Drop off your presentation to be judged on December 11, time TBA

Template for Your STEM Fair Board

After you are finished your experiment, it is time to put it all together in a STEM Fair Board. This is a visual presentation of what you did and should include all the parts of the scientific method. Your poster should be easy to read, interesting and also tell the most important parts of your project to the judges. You should include photos of your process and graphs to share your data. You can use the template on the school STEM Fair webpage to help you. Additionally, there is a great online course, “Student Researcher Training Modules” through UNM STEM-H Learning Lab (they also put on our regional STEM Fair), which can be found here: https://hsc.unm.edu/stem-h/programs/learning-lab/.

Here is a brief overview of what your board should include:



Preparing for Your STEM Fair Presentation

Presenting to the judges is an important part of your project. You should take some time to practice how you will talk to the judges about your STEM Fair project.

- Practice talking about your STEM Fair project ahead of time. You can practice speaking out loud to yourself in front of a mirror, to your grown up, a friend, or a sibling.
- On the day of the STEM Fair, wear nice clothes.
- Use good manners and introduce yourself to the judges.
- Don't be afraid to say "I don't know." or "I haven't thought about that yet."
- Include graphs, photos and models (if appropriate) with your STEM Fair Board. Use these to help you explain your project.
- Relax, smile and have fun!

Here are some questions the judges might ask you. You should think about these questions to help you prepare for your presentation.

- Where did you get this idea?
- What made you choose this project?
- What would you do differently next time?
- What was the hardest part for you?
- What research did you do for this project?
- Why did you do your testing more than once?
- Why are your findings important?
- Why should this project/topic matter to other people? What impact does this have on others?
- What is the most important thing you learned from this project?
- Who helped you? (This sounds like a trick question because you were supposed to do your own project - BUT no scientist or engineer works in isolation. Acknowledge your parents, teachers, friends, and anyone else that gave you advice, equipment, helped you find materials, or other help.)

Rubric

A rubric is the guidelines by which your project will be judged. As you go through your project, read the rubric to make sure that you have included all the necessary parts and judge yourself to see how well you think you would do. This is a good way to reflect on your board and presentation to see how you might improve.

Science Project Rubric

	1 (Developing)	**2 (Approaching)**	**3 (Meeting)**	**4 (Exceeding)**
Research Question What the student wants to find out	States an incomplete or vague question that can't be tested, OR may address a question to which they already know the answer.	States a research question that is clear and focused but is not testable OR states a question that is testable but not focused.	States a question with a clear and focused purpose that is testable using scientific methods.	States a complete, well written question that **demonstrates critical thinking skills**,and represents a learning opportunity and is testable using scientific methods.
Design & Methodology ● Materials ● Procedures ● Variables & controls	At least 1 of the design elements: materials, procedures, variables & controls is not present. The remaining elements are vague or unclear.	All 3 design elements: materials, procedures and variables are represented. At least 2 of the 3 are complete and related to the research question.	All 3 design elements are present. Materials and procedures are complete, listed step-by-step, and linked to the hypothesis. Variables and controls are defined, appropriate and complete.	All 3 design elements are present. Materials and procedures are outlined in a step-by-step fashion **that could be easily replicated**. All variables and controls are defined, appropriate and complete.
Execution ● Data Collection ● Data Presentation ● Conclusion ,	Insufficient data or written observations collected. Poor or no use of photos, charts, or graphs to display data.	Data and observations were collected, but are not complete. Data and graphs are attempted for displaying existing data.	Adequate data or written observations collected. Good use of photos, charts, or graphs to display data. Enough data collected to	Substantial data or written observations collected. Outstanding use of photos, charts, or graphs to display data in a meaningful way.

	Conclusion may not be present.	Conclusion is attempted but vague or incomplete.	support conclusions. Grade level appropriate application of mathematical methods. Conclusion is sound based on provided data.	Multiple repetitions were performed to demonstrate validity. Conclusion expertly interprets the procedure and data collected.
Creativity Imagination and inventiveness and/or offering different perspectives that open up new possibilities for experimentation.	Does not demonstrate creativity in any of the above 3 criteria	Demonstrates creativity in **1** of the above 3 criteria	Demonstrates creativity in **2** of the above 3 criteria.	Demonstrates creativity in **all 3** of the above criteria
Presentation (Board) Readability, organization and visual appeal	Display board has limited eye appeal or is not easily readable. Display has limited organization, or has confusing visuals. Contains multiple spelling and grammatical errors that are not grade-appropriate.	Display board has a combination of confusing AND readable parts. Some visuals are confusing and others are helpful. A few spelling and grammatical errors that are not grade-appropriate.	Display board is appealing, neat, and readable. It is organized and clear, uses understandable visuals. Spelling and grammar are grade appropriate.	Display board is logical, neat, attractive, and creative. Makes striking use of inventive and eye catching visuals. Supporting documentation displayed. Spelling and grammar are grade-appropriate.
Presentation (Interview) Presenter's ability to discuss their project and answer questions about their project	Student partially answered questions. Does not demonstrate independence in understanding the project. Poor understanding of the project and no mention of how their project impacts others.	Student can answer some questions regarding the project. Limited degree of independence in conducting the project. Cannot speak about the project beyond what is presented on the	Student can answer most questions. Adequate understanding of interpretation and limitations of results and conclusions. Satisfactory degree of independence in conducting the	Student demonstrated clear, concise, thoughtful responses to questions. Thorough understanding of interpretation and limitations of results and conclusions. High degree of

		board and does not mention how their project impacts others.	project. Able to provide some information and answer some questions that are not already represented on the board. Briefly or superficially mentions the impact of their work.	independence in conducting project. Excellent understanding of the project and quality ideas for further research. Can thoroughly answer questions that are not represented on the board as well as how their project impacts others and why the work is meaningful.